Minor Gas Observations

AIRS Science Team Meeting

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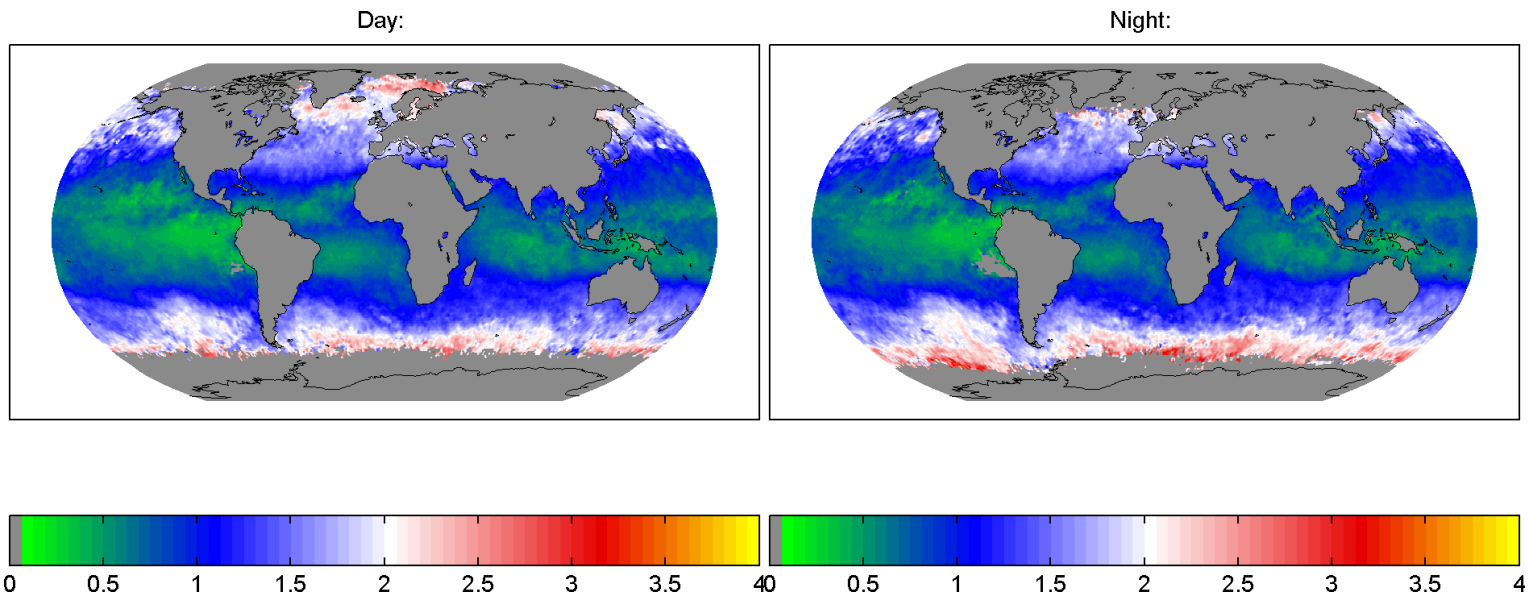
Overview

- Minor gases (and aerosols) are both an asset and a nuisance for AIRS
- My perspective: performance and validation of RTA, use of radiances for climate monitoring
- Minor gases and dust must be taken into account for T(z) and H_2O (z) products, and for future climate applications
  1. HNO_3?
  2. CO_2 for climate change monitoring
  3. CH_4 for sources and sinks
  4. CO for atmospheric chemistry
  5. Volcanic SO_2 and ash for sulfur budget, aircraft safety
- We are finding more and more channels are impacted by variable gases
- AIRS, followed by IASI on METOP and CrIS on NPOESS can potentially provide new information on the long-term variability of a number of minor gases. Special chemistry satellite missions come and go.

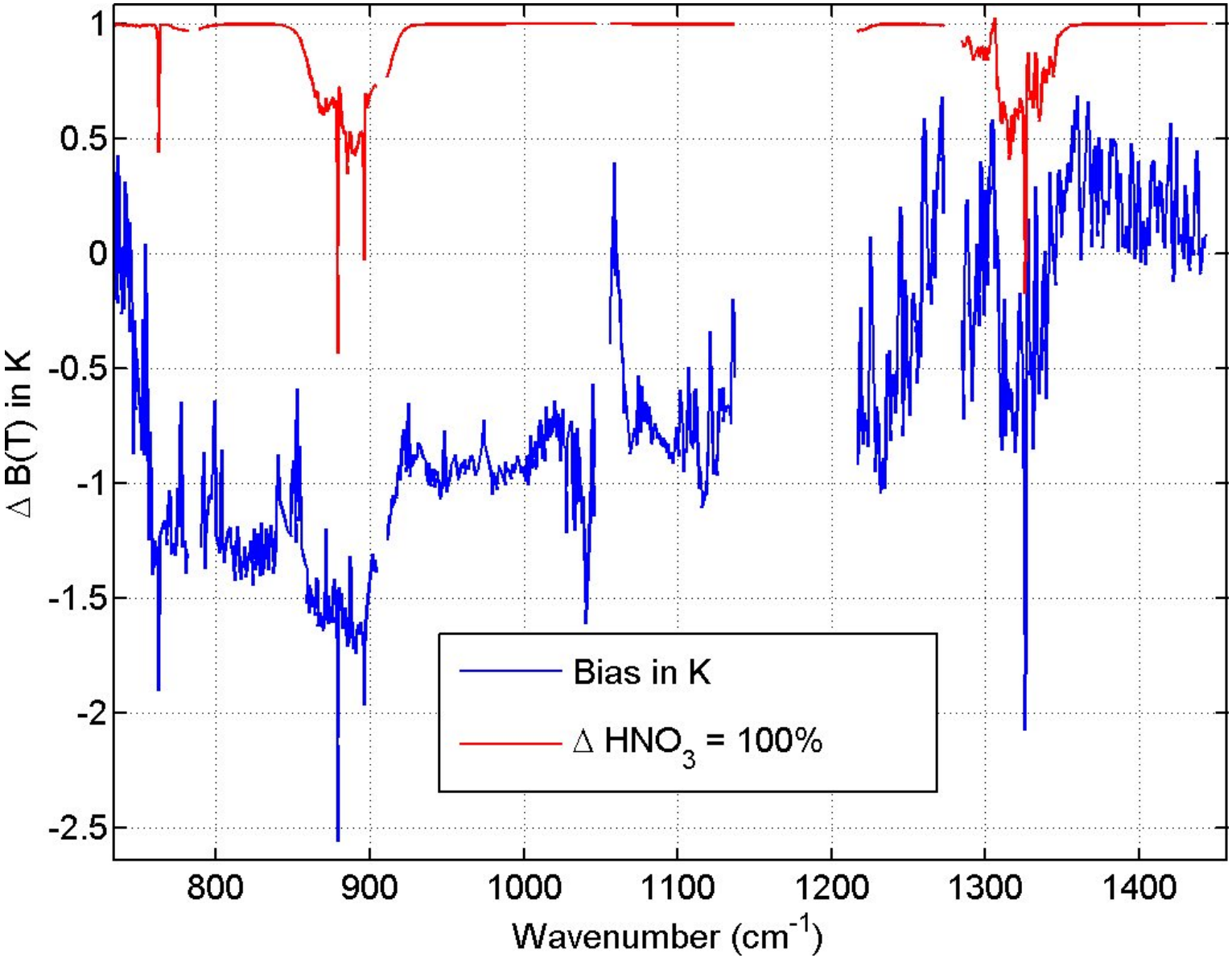
ASL

May 2004 Monthly Means of HNO_3

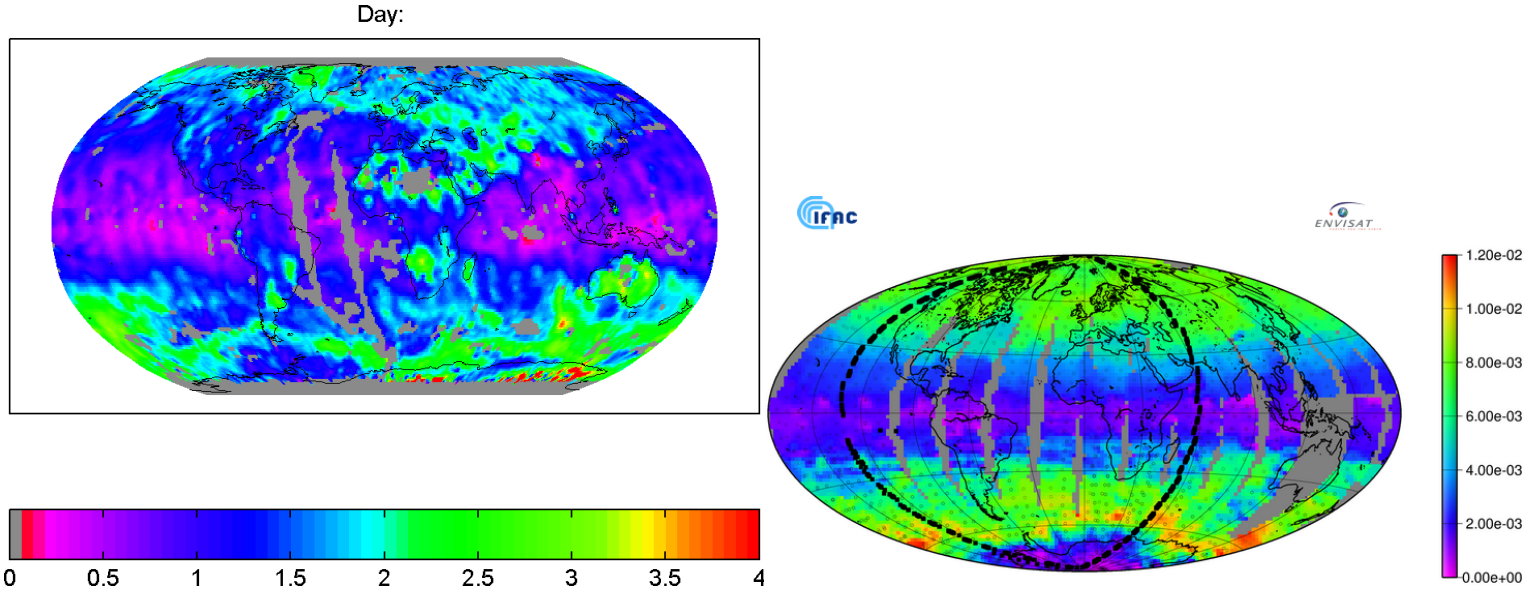
- RTA modified to include variable HNO_3
- Used L2 retrievals, just varied scalar multiplier of HNO_3 column
- HNO_3 unit is (observed column)/(reference column). Reference column is $\approx 10^{14}$ mol/cm^2
- Ocean only

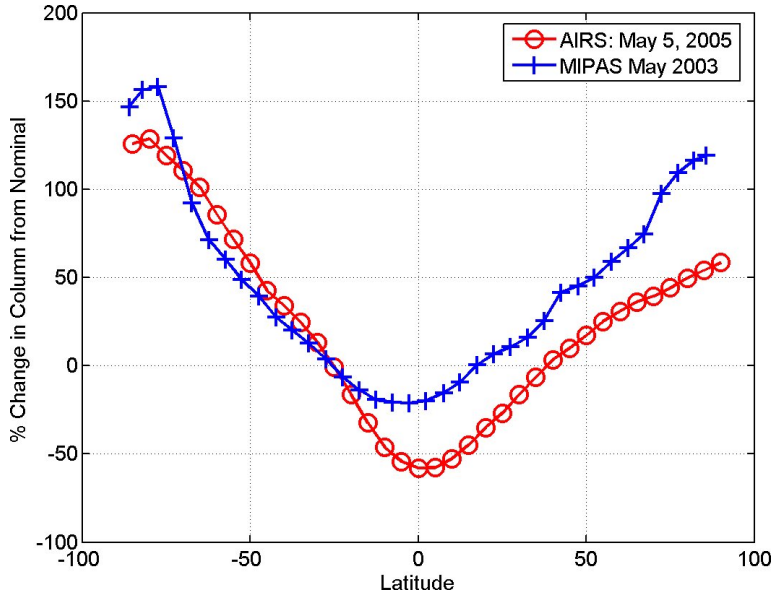


HNO_3 Signal in Polar Granule Residuals

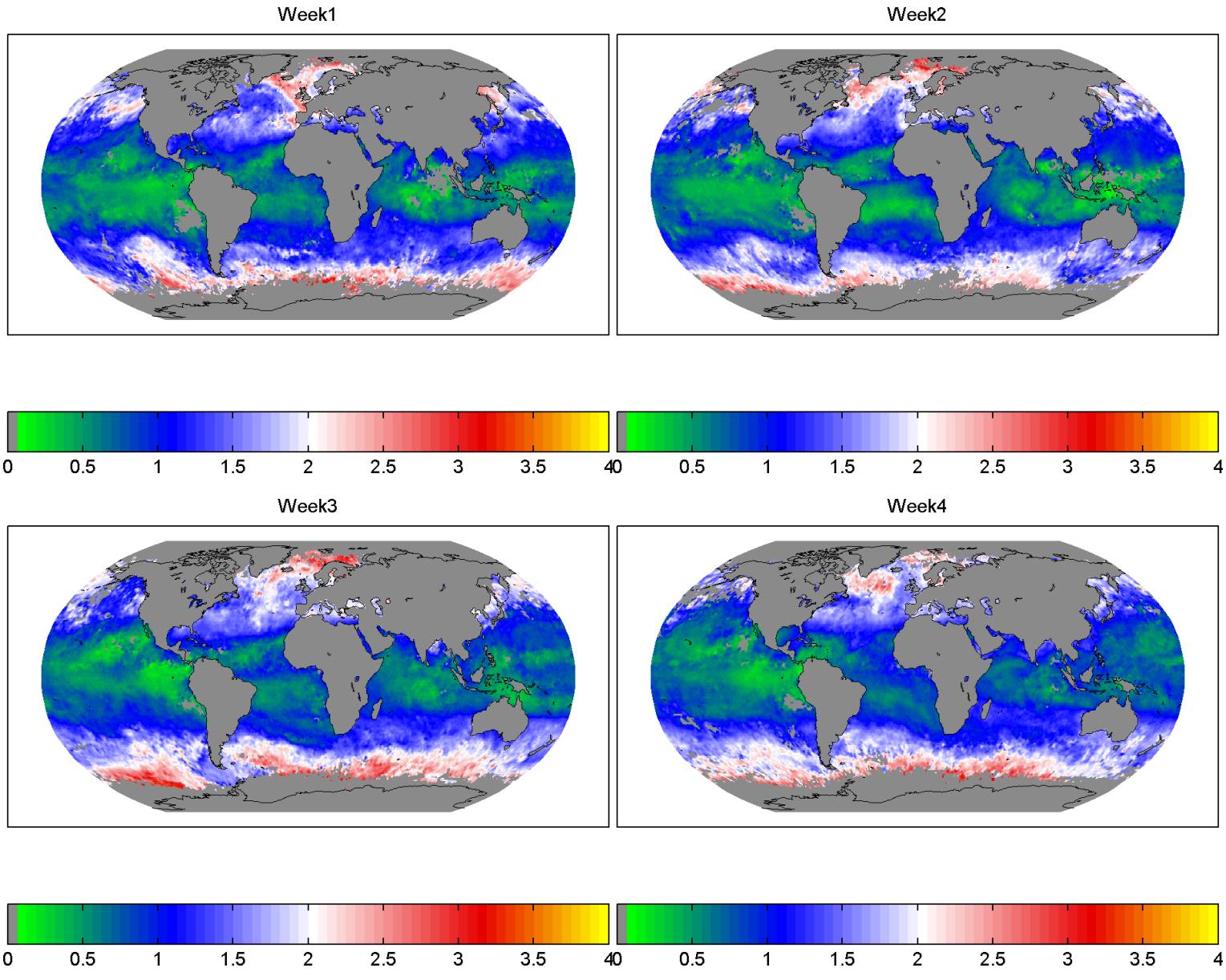


Very Rough Validation versus MIPAS

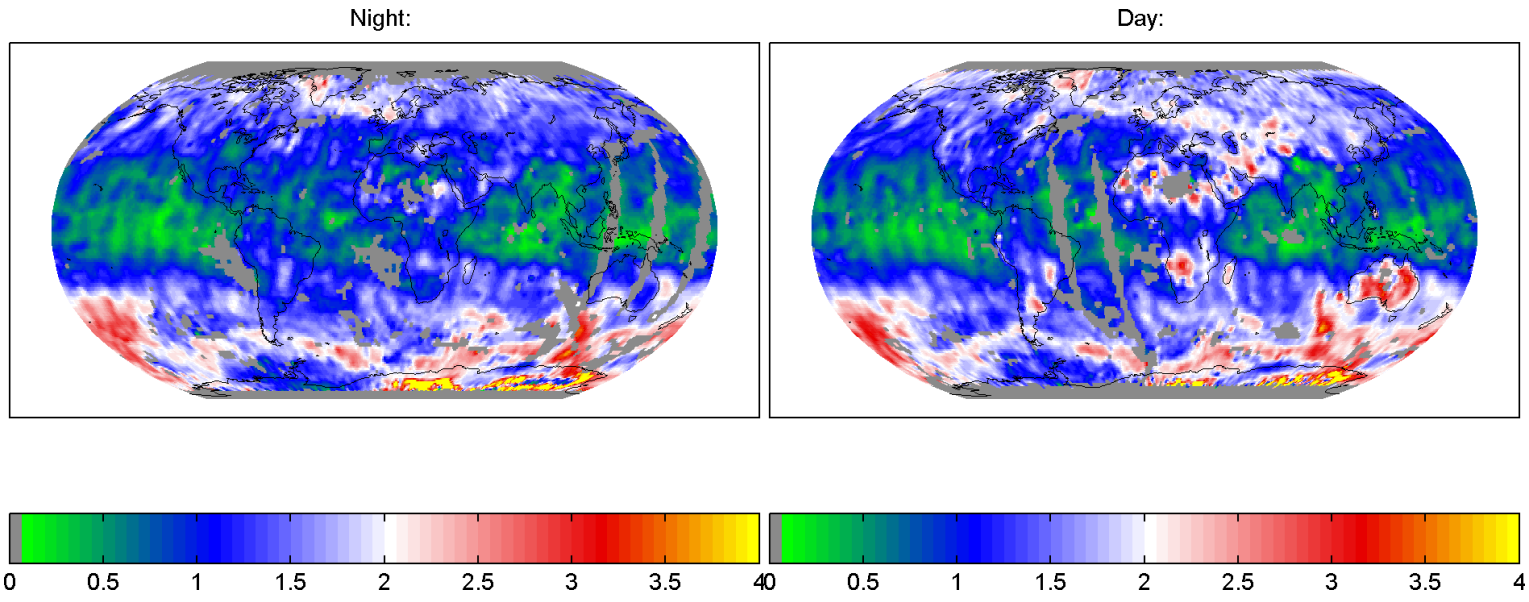




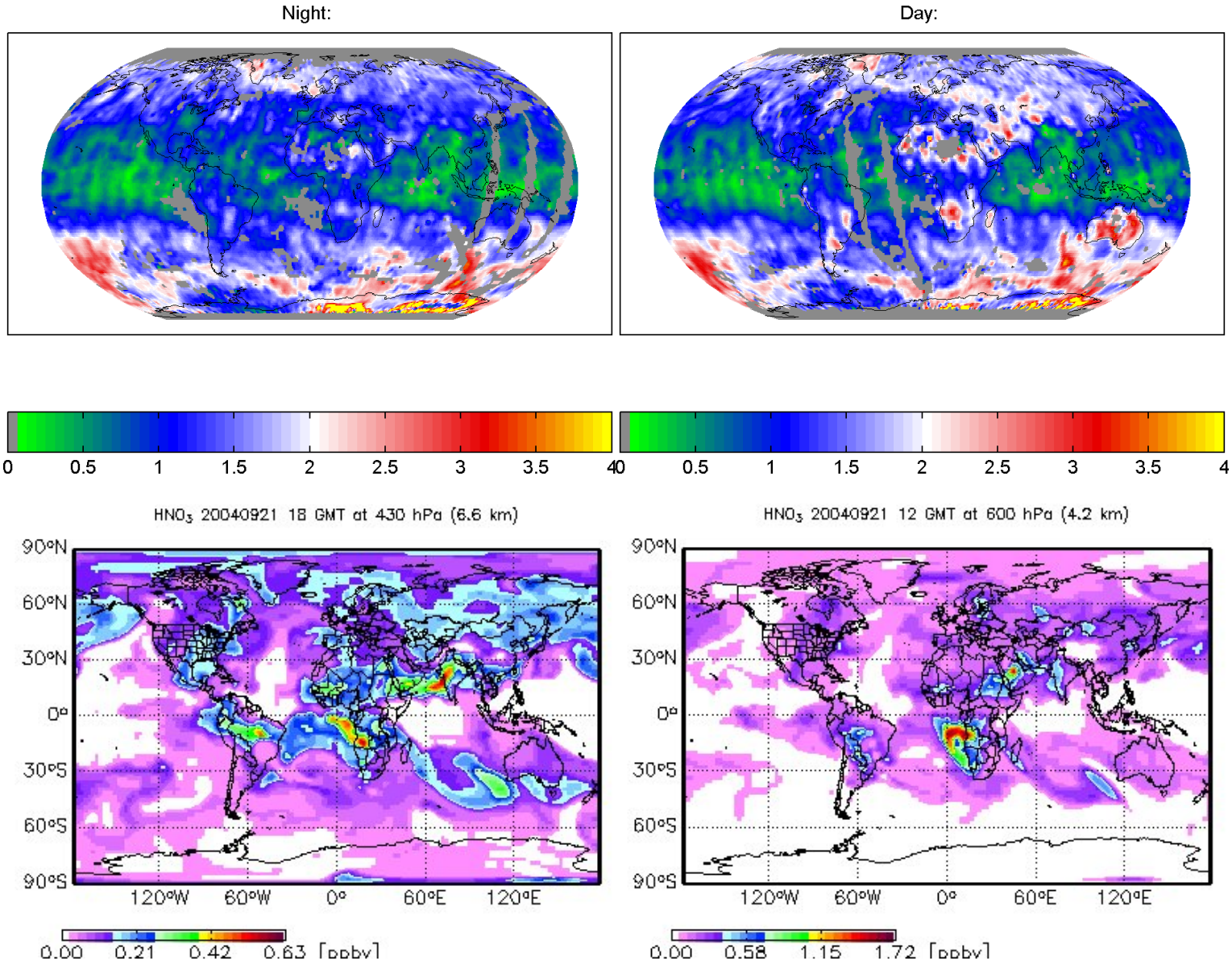
May 2004 HNO_3 Retrievals Binned by Week



GEOS-CHEM: Sept. 20-21, 2004, 220 and 310 mbar

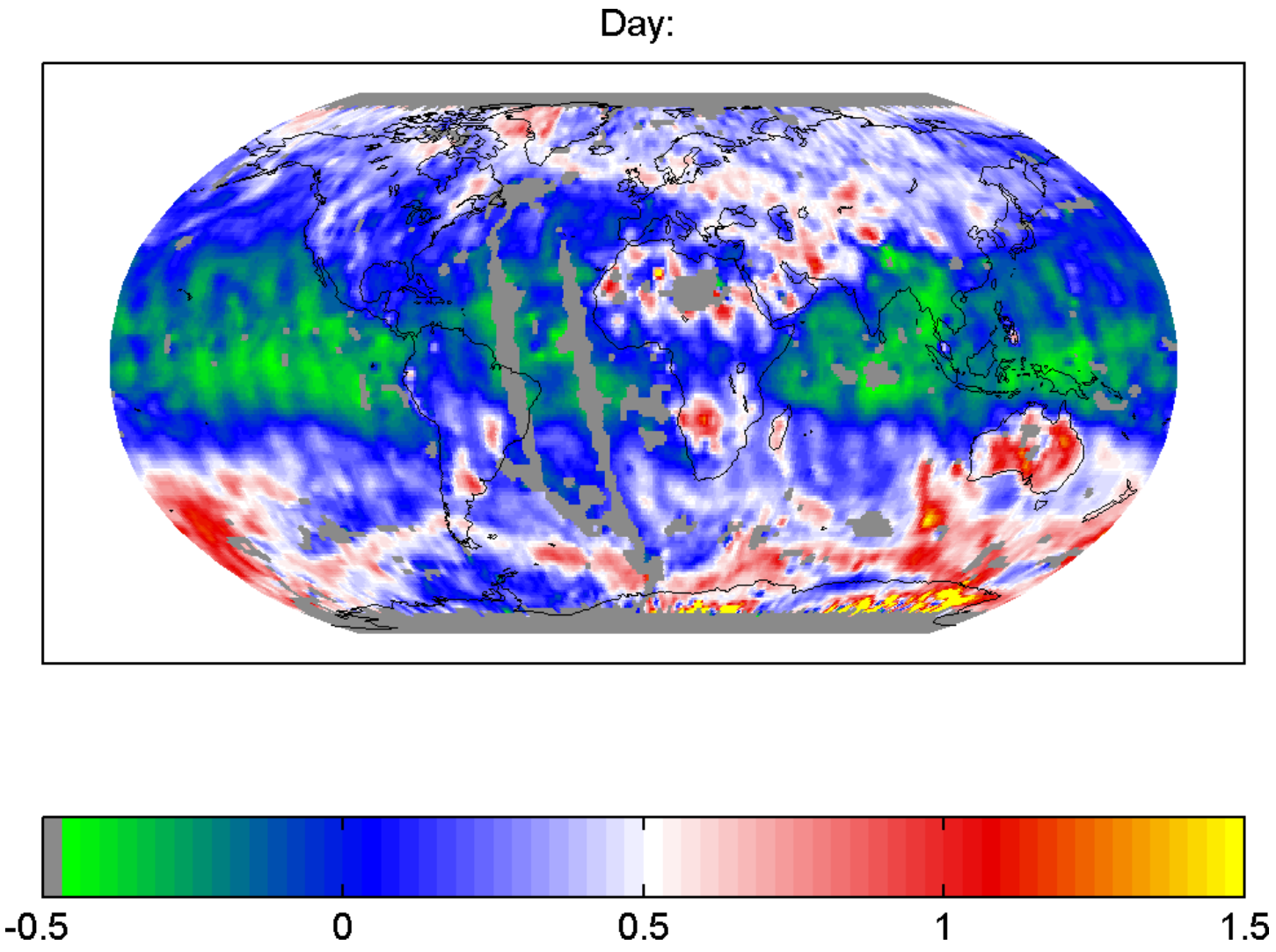


GEOS-CHEM: Sept. 20-21, 2004, 430 and 600 mbar



B(T) Influence for 1X Change in HNO_3, Channel 1440

- About 5 channels this sensitive
- 189 AIRS channels have $dB(T)/d(HNO_3 = 1X) > 0.1K$



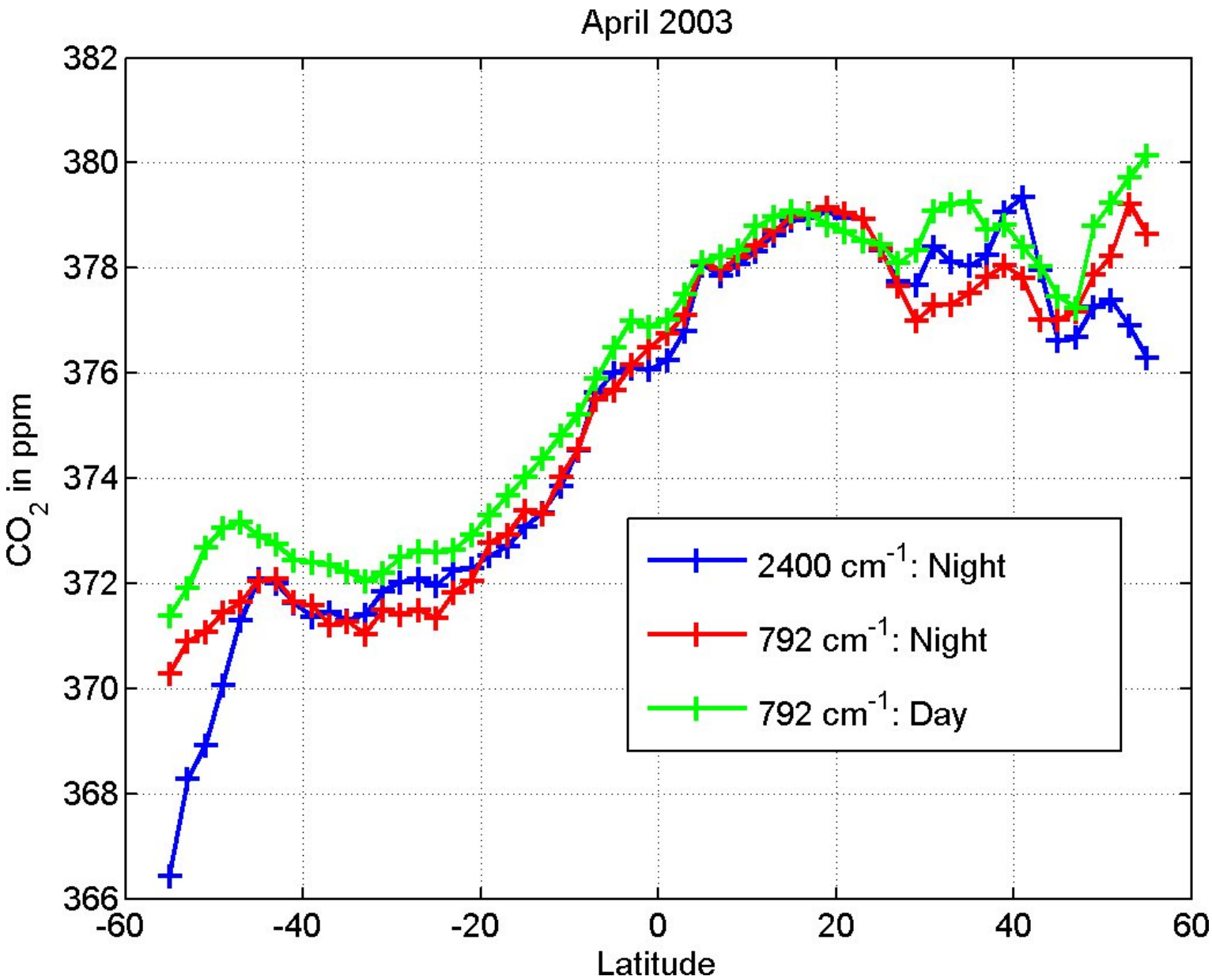
Conclusions: HNO_3

- AIRS has good sensitivity to HNO_3
- Signals arising from range of profiles, unlikely to have much profile information.
- Retrievals must avoid, or take into account, channels sensitive to HNO_3
- Climate studies with AIRS should take HNO_3 into account, or avoid spectrally
- Solar flares can greatly increase HNO_3 and impact AIRS retrievals.

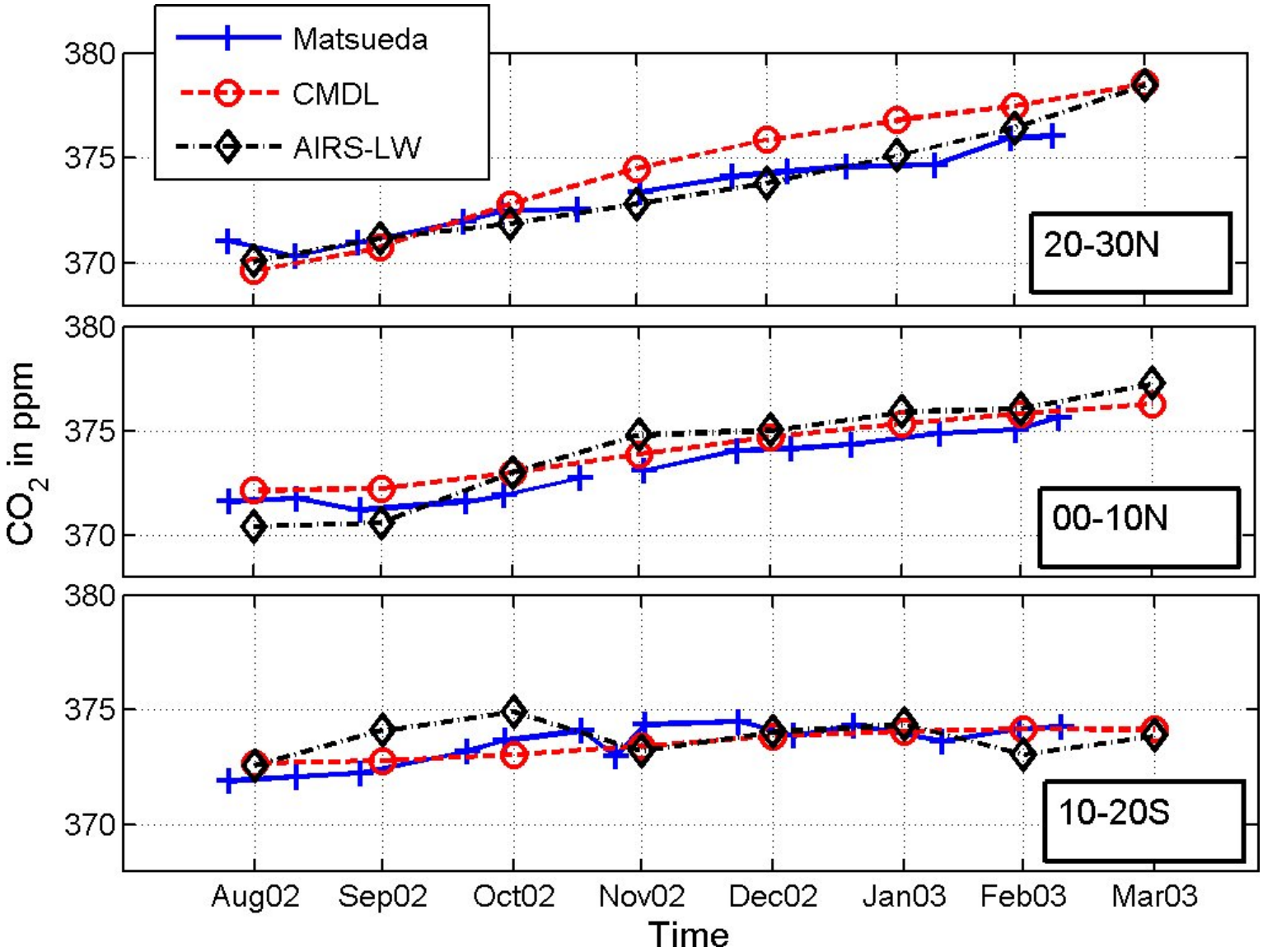
CO_2 Climatology with AIRS

- Presented in previous meetings
- Good agreement with CMDL
- Longwave and shortwave agree very well, implies that my use of ECMWF temperature fields for these statistical measurements is OK since shortwave is ~2X more temperature sensitive
- The best channels by far are in the 2400 cm^{-1} shortwave region
- We will soon have processed more than 3-years of data

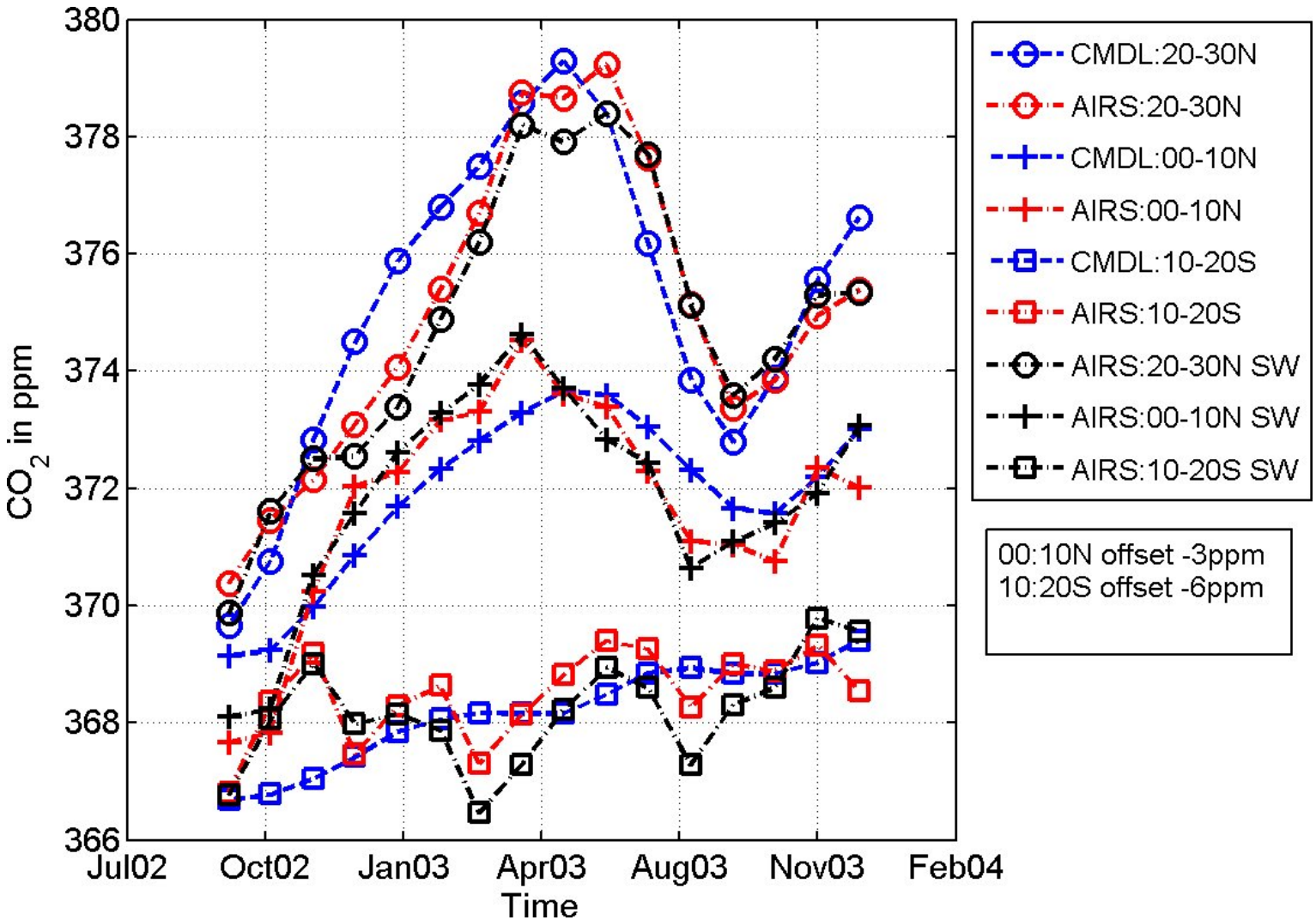
Good Agreement Between Short and Longwave CO_2



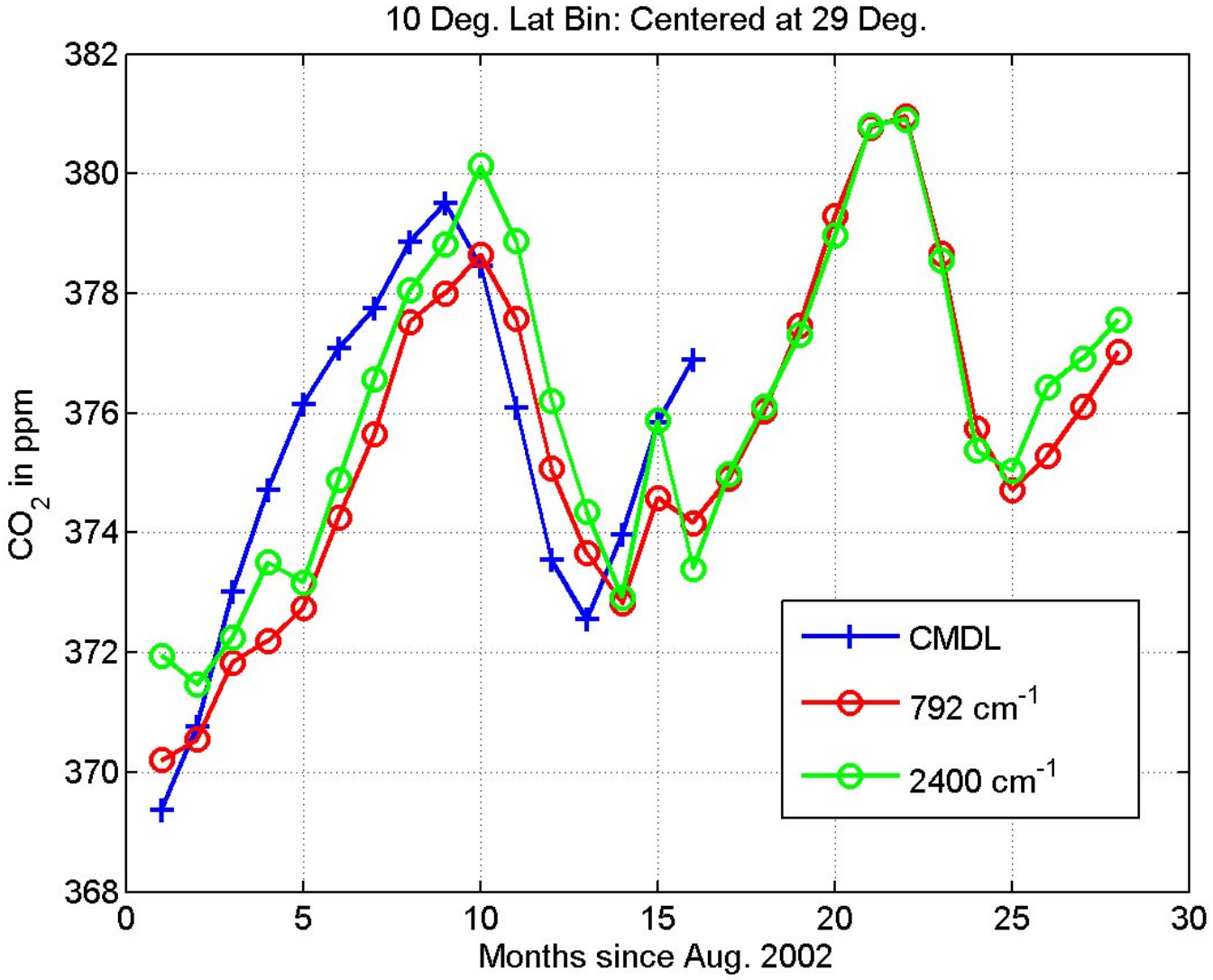
Comparison to Matsueda



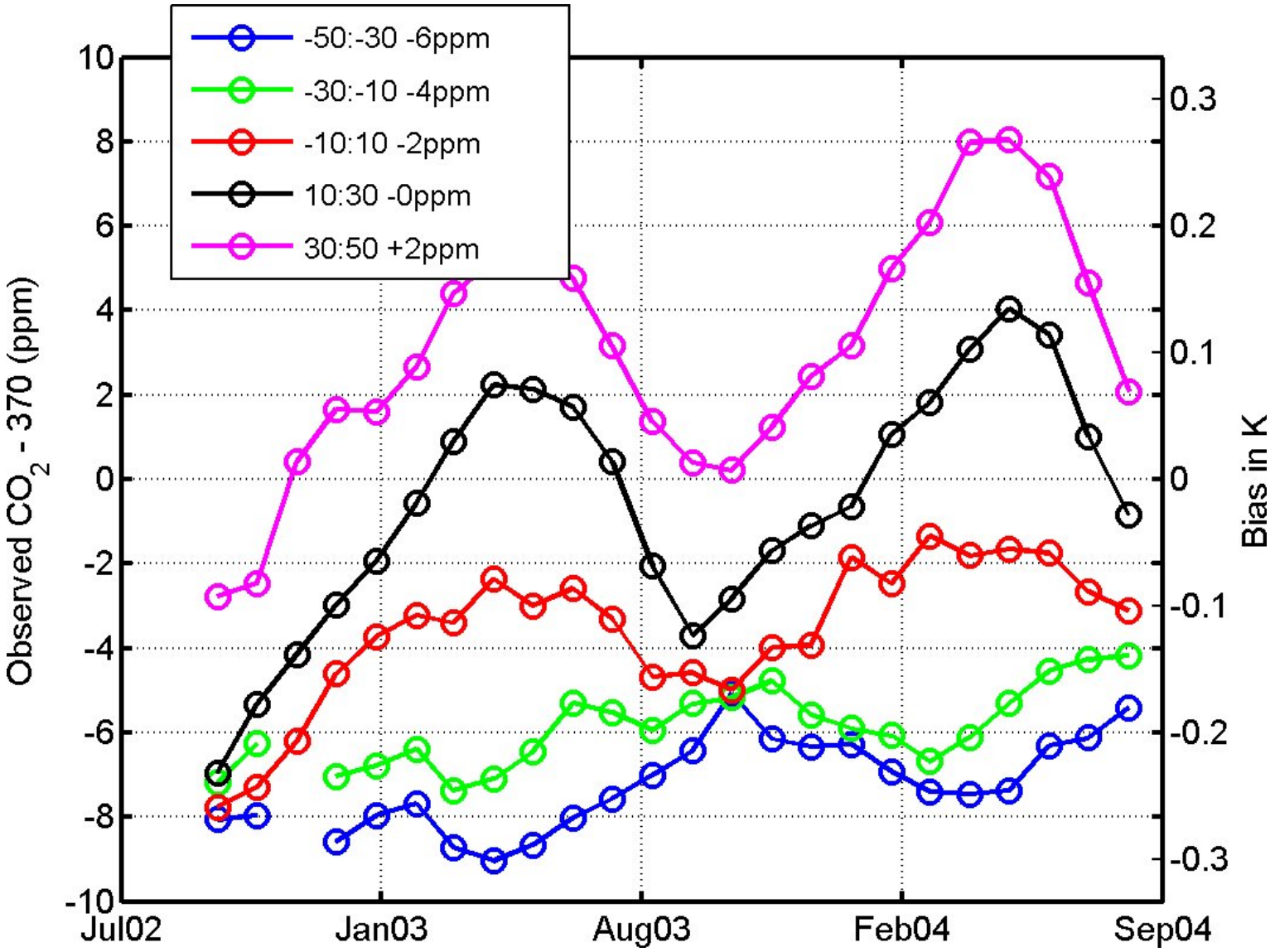
CO_2 Climatology: Short and Long Wave vs CMDL



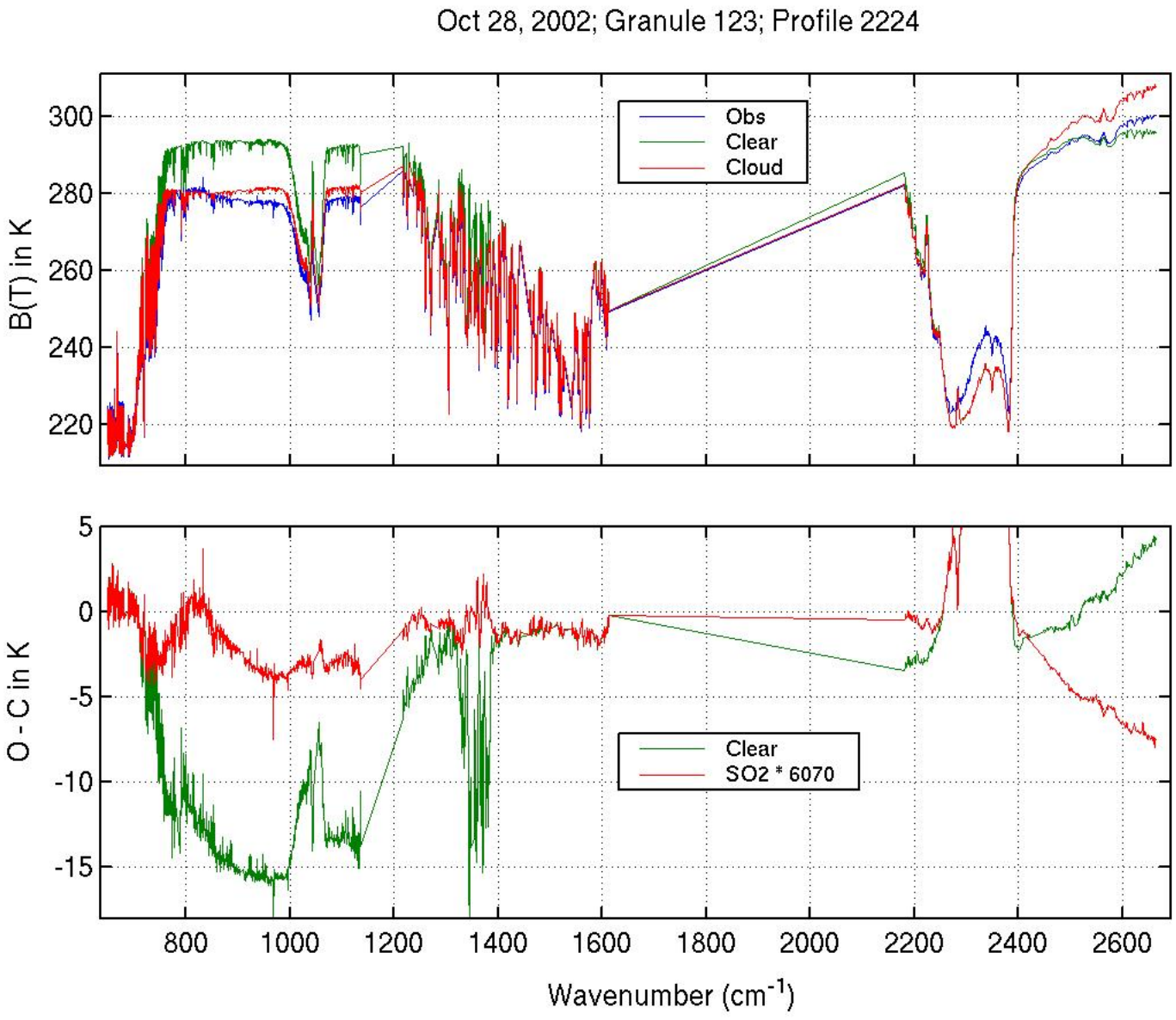
A Possible Phase Lag Relative to CMDL



Phase Reversal in S. Hemis. Seen

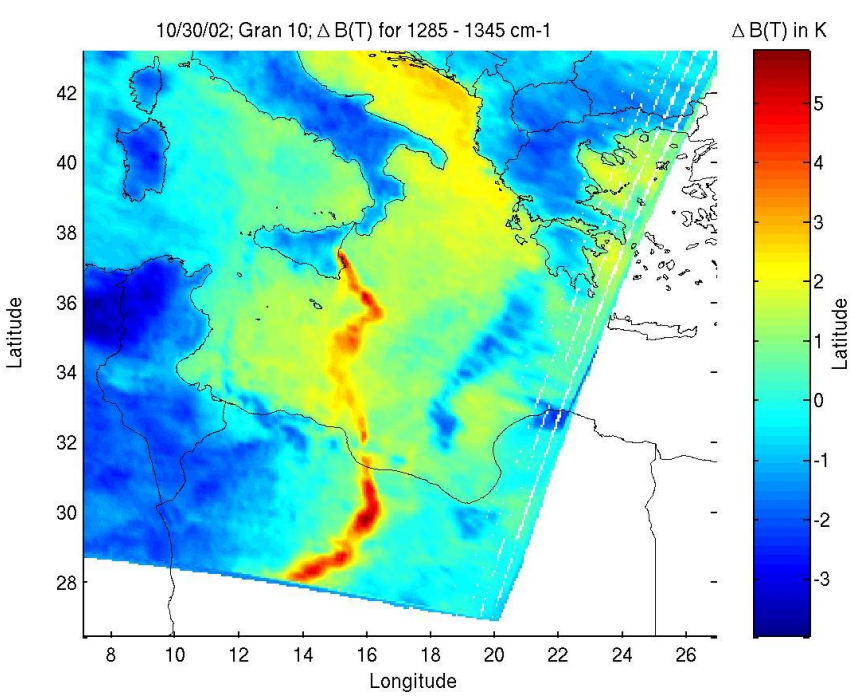


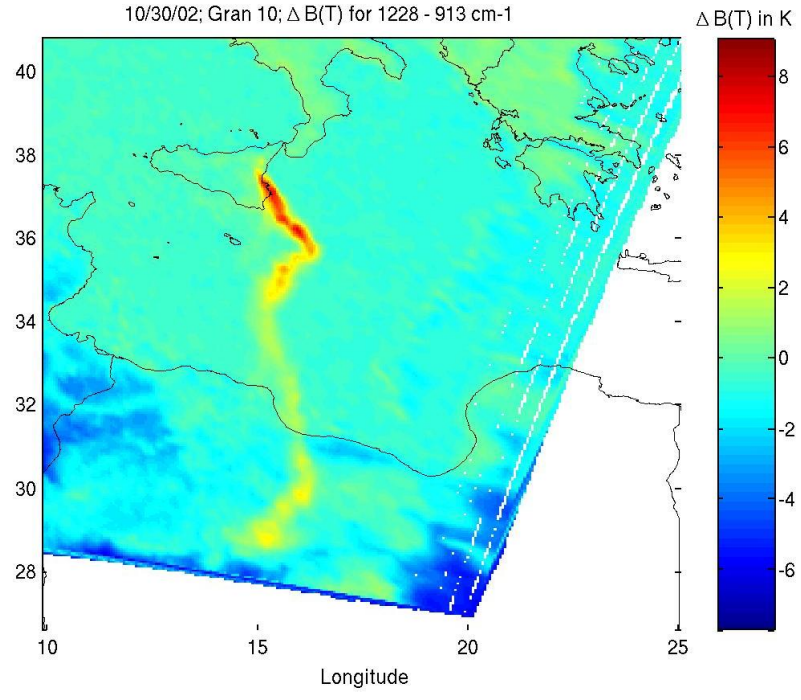
SO_2 Signal; Variable SO_2 Now in RTA



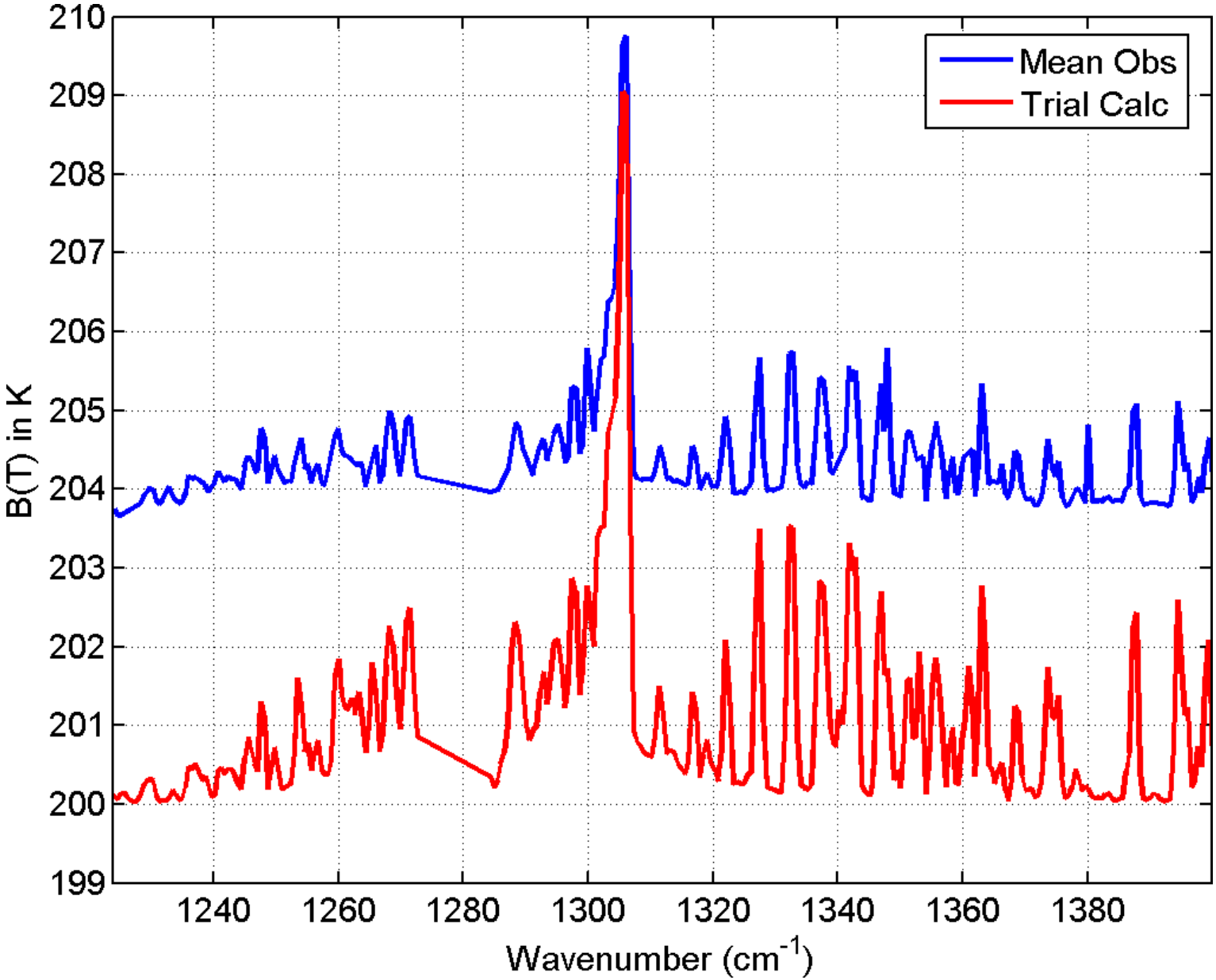
Mt. Etna Eruption 2002, Retrieved SO_2 and Ash Optical Depths

See GRL paper, Jan. 2005



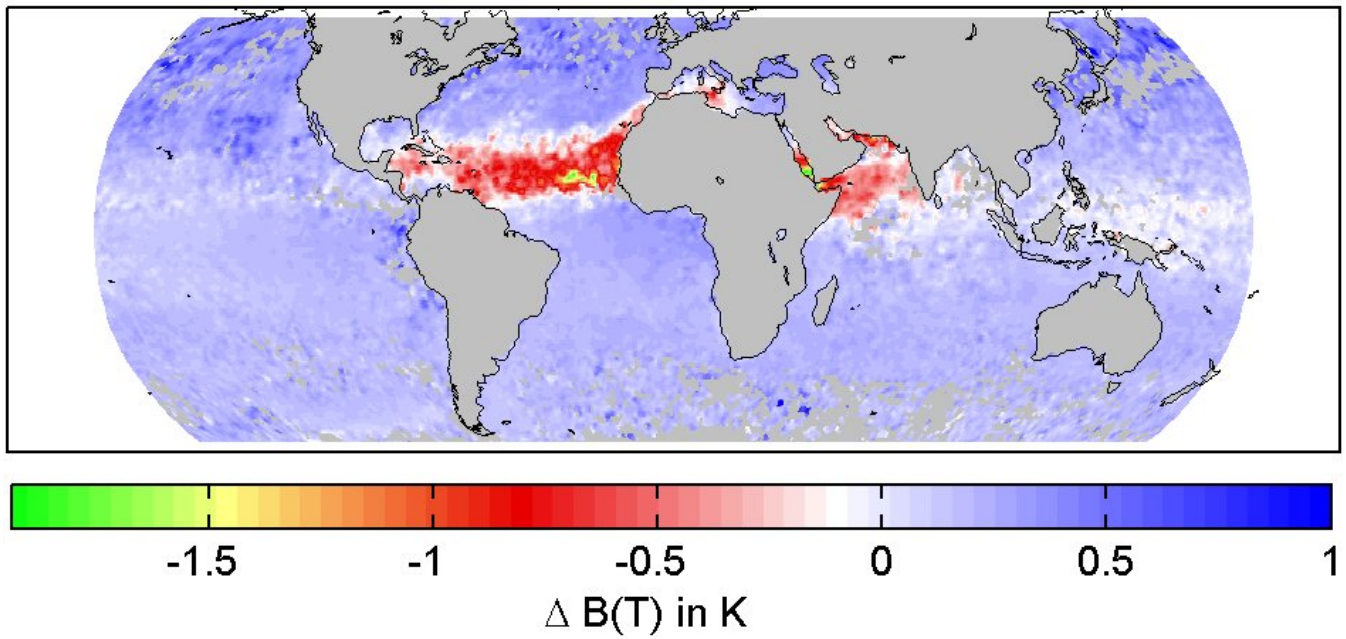


High Altitude CH_4



Mineral Dust

Work continues on dust retrievals. See GRL paper, Feb. 2006



Conclusions

Very few AIRS channels are free from “contamination” by variable minor gases and water vapor. Climate studies will require careful attention to their role in the radiances.